What is claimed is:

1. A manufacturing method of silicon carbide single crystals, comprising the steps of:

providing a silicon carbide single-crystal substrate having a micro-pipe therein;

applying temperature difference in a thickness direction of the substrate so that temperature at a front surface of the substrate is lower than that at a back surface of the substrate that is disposed opposite to the front surface;

supplying a gas containing at least carbon and a gas containing at least silicon to the front surface to form a silicon carbide film by epitaxial growth.

2. A manufacturing method of silicon carbide single crystals according to claim 1, wherein temperature of the substrate is set at 1650 °C or more.

3. A manufacturing method of silicon carbide single crystals according to claim 2, wherein the temperature of the substrate is set in a range from 1750 to 1900 °C.

4. A manufacturing method of silicon carbide single crystals according to claim 1, wherein the temperature difference is caused by supplying a gas containing at least one of hydrogen and helium to the front surface of the substrate.

5. A manufacturing method of silicon carbide single crystals according to claim 1, wherein flow rate of the gas containing carbon and the gas containing silicon is set at 1 m/sec or more just before reaching the substrate.

6. A manufacturing method of silicon carbide single crystals according to claim 1, wherein the temperature difference is set at 0.5 °C or more.

7. A manufacturing method of silicon carbide single crystals according claim 6, wherein the temperature difference is set at 5 °C or more.

8. A manufacturing method of silicon carbide single crystals according to claim 1, wherein the silicon carbide film includes a film formed by epitaxial growth in which a growth rate is at 20 μm/h or more.

9. A manufacturing method of silicon carbide single crystals according to claim 1, wherein a thickness of the substrate is 300 μm or more.

10. A manufacturing method for forming silicon carbide single crystals according to claim 1, further comprising:

disposing the silicon carbide substrate on which the silicon carbide film is formed by the epitaxial growth in a chamber as a seed crystal;

supplying a sublimation gas sublimed from a source material in the chamber; and

recrystallizing the sublimation gas on the seed crystal.

11. A manufacturing method of silicon carbide single crystals forming a silicon carbide film by epitaxial growth on a silicon carbide substrate having a micro-pipe, comprising the steps of:

holding said substrate by a holding means; and

setting flow direction of a gas containing carbon and a gas containing silicon in approximately perpendicular to a front surface of the substrate that has an opening of said micro-pipe, so that said silicon carbide film is formed on the front surface of the silicon carbide substrate by epitaxial growth, wherein flow rate of the gas containing carbon and the gas containing silicon is set 1 m/sec or more.

12. A manufacturing method of silicon carbide single crystals according to claim 11, wherein temperature of the surface of the substrate is set at 1650 °C or more.

13. A manufacturing method of silicon carbide single crystals according to claim 12, wherein the temperature of the surface of the substrate is set in a range from 1750 to 1900 °C.

14. A manufacturing method of silicon carbide single crystals according to claim 11, wherein said micro-pipe

penetrates the substrate from the front surface to a back surface thereof, and the substrate is held so that the back surface thereof closely contacts a contacting member.

15. A manufacturing method of silicon carbide single crystals according to claim 11, wherein said micro-pipe penetrates the substrate from the front surface to a back surface thereof, and the substrate is held so that pressure of an atmosphere contacting the back surface is high as compared to that of an atmosphere contacting the front surface.

16. A manufacturing method of silicon carbide single crystals according to claim 11, wherein the silicon carbide film is formed by the epitaxial growth in reduced pressure.

17. A manufacturing method for forming silicon carbide single crystals according to claim 11, further comprising:

disposing the silicon carbide substrate on which the silicon carbide film is formed by the epitaxial growth in a chamber as a seed crystal;

supplying a sublimation gas sublimed from a source material in the chamber; and

recrystallizing the sublimation gas on the seed crystal.

18. A manufacturing method for forming silicon carbide single crystals on a silicon carbide substrate having a micro-pipe, comprising the steps of:

modifying step for enlarging an opening of the micro-pipe that is disposed at a front surface of the substrate; and

film growing step for forming a silicon carbide film by epitaxial growth supplying a gas containing at least carbon and a gas containing at least a silicon to the front surface of the substrate.

19. A manufacturing method for forming silicon carbide single crystals according to claim 18, wherein the substrate is heated up to 1650 °C or more while a carrier gas containing hydrogen flows on the front surface of the silicon carbide substrate in the modifying step.

20. A manufacturing method for forming silicon carbide single crystals according to claim 18, wherein a carrier gas containing chlorine flows on the front surface of the silicon carbide substrate in the modifying step.

21. A manufacturing method for forming silicon carbide single crystals according to claim 18, wherein the silicon carbide substrate is etched using KOH in the modifying step.

22. A manufacturing method for forming silicon carbide single crystals according to claim 18, wherein the opening of the micro-pipe is enlarged so that a diameter thereof becomes twice or more in size as compared to that before enlarged.

23. A manufacturing method for forming silicon carbide single crystals according to claim 18, further comprising:

disposing the silicon carbide substrate on which the silicon carbide film is formed by the epitaxial growth in a chamber as a seed crystal;

supplying a sublimation gas sublimed from a source material in the chamber; and

recrystallizing the sublimation gas on the seed crystal.

24. A silicon carbide substrate comprising:

a silicon carbide single crystal body having a micro-pipe which is hollow and has a pipe-shaped portion and an opening whose diameter increases as being close to a front surface of said substrate, the pipe portion being located at a side of a back surface of the silicon carbide single crystal body, and the opening being located at a side of the front surface of the silicon carbide single crystal body; and

a silicon carbide epitaxial film formed on the front surface of the silicon carbide single crystal body so as to cover the micro-pipe, wherein the micro-pipe is eliminated in the silicon carbide single crystal body.

25. A silicon carbide substrate according to claim 24, wherein:

the diameter of the opening, which is enlarged at a top thereof, is twice or more as large as that of the opening at a bottom thereof where the pipe portion is connected.

26. A silicon carbide substrate comprising:

a conductive silicon carbide substrate body having a micro-pipe; and

a silicon carbide epitaxial film formed on a front surface of the substrate, wherein:

the silicon carbide epitaxial film covers the micro-pipe, and the micro-pipe is eliminated at a conductive region which is located between the conductive silicon carbide substrate body and the silicon carbide epitaxial film.

27. A silicon carbide substrate according to claim 26, wherein said conductive region is the conductive substrate body.

28. A silicon carbide substrate according to claim 26, wherein said conductive region is the conductive epitaxial film.

29. A silicon carbide substrate according to claim 26, wherein the conductive epitaxial film has a low resistive epitaxial film and a high resistive epitaxial film formed on the low resistive epitaxial film, wherein said conductive region is the low resistive epitaxial film.